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A New Weapon Against Insects

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The Forage-Seed Revolution

Major changes have occurred in forage crop seed production in the past 20 to 25 years. Most of them are based on research by USDA and State experiment station scientists.

Few improved varieties had been developed before the mid-1930's. Production was erratic and the small amount of certified seed available was often so expensive that farmers wouldn't buy it.

It's a different story today. New grasses and legumes come out frequently, and the seed supply of many of them amounts to millions of pounds. What caused this dramatic change in quality and quantity of grass and legume seeds?

First of all, farmers and agricultural leaders began to better appreciate the importance and value of the billion-acre grassland that covers about half of the United States.

More scientists were put to work studying seed-production problems and breeding better varieties. Seed certification services were expanded. The International Crop Improvement Association worked out minimum standards to ensure reasonable uniformity of certified seed.

Researchers also discovered the key to mass production of certified seed. The problem centered around a requirement that seed could be certified only when grown in the region to which the variety was adapted. The scientists found, however, that growing a limited number of generations of a variety in a specialized seed-production area wouldn't damage forage crops significantly, even though the variety was adapted to a different area. So certification standards were expanded.

Still, farmers in the East and Midwest—areas where weather is a constant threat to successful grass and legume seed production—didn't get much seed of adapted varieties.

Then, in 1943, the Foundation Seed Project was organized to relieve seed shortages. Increasing a handful of pure parent stock seed to millions of pounds of certified seed for farmers is a complex process. But the job of supplying more and better seed doesn't stop with quantity production.

Seed production specialists conduct longtime trials to make certain that seed production and breeding are carried out to maintain a plentiful, economical supply.

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AGRICULTURAL RESEARCH SERVICE
United States Department of Agriculture

A new weapon against insects ...

CHEMOSTERILANTS

Sterilants, if used with insecticides, may provide a powerful means of controlling or eradicating several destructive pests

■ The possibility of using chemicals to sexually sterilize insects—as a means of control or eradication by preventing reproduction—is no longer just a scientific theory.

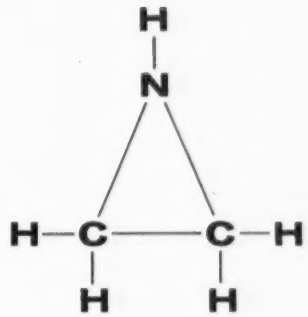
By treating laboratory-reared insects with minute quantities of sterilizing chemicals (chemosterilants), USDA scientists have completely halted reproduction in test colonies of several species—houseflies, mosquitoes, stable flies, screwworms, boll weevils, and Mexican fruit flies. Sterilized females laid no eggs, and the eggs laid by fertile females that mated with sterile males did not hatch. Sexual vigor and mating behavior were not affected.

In a preliminary field test, ARS entomologists of Orlando, Fla., almost eliminated a population of houseflies infesting a partially isolated refuse dump on a small uninhabited island. After 5 weekly applications of a bait containing a chemosterilant, only a few flies could be found, and 99 percent of those captured were sterile.

As expected, the island was repopulated by houseflies from nearby islands and the mainland. Tests on a completely isolated island will be required to determine if eradication of houseflies can be achieved with chemosterilants.

Turn Page

Parent Chemical



Most promising of the insect sterilants tested are several derivatives of ethylenimine, a family of chemicals.

CHEMOSTERILANTS

(Continued)

The potential advantages of inducing sterility to control insects were first suggested by E. F. Knipling, head of USDA entomology research (AGR. RES., March 1960, p. 9). This principle of insect self-annihilation is being intensively explored in ARS laboratories at Orlando; Kerrville, Tex.; Honolulu, Hawaii; and Mexico City, Mexico. Preliminary studies are also underway at other ARS laboratories. The scientists believe successful application of this principle could help us get rid of many destructive and dangerous insect pests.

The sterility technique was successfully used in 1953–59 to eradicate the screwworm from the Southeast (AGR. RES., July 1958, p. 8; March 1960, p. 15). In that program, laboratory-reared screwworm flies were sexually sterilized by exposure to radioactive cobalt 60 and released weekly in sufficient numbers to reduce and finally wipe out the native screwworm population.

Advantages offered by chemicals

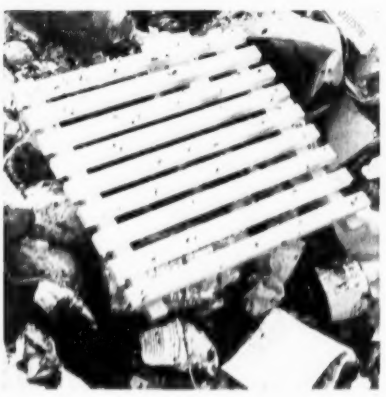
Chemosterilants have been studied for less than 5 years, but early results indicate they have advantages over the use of radiation:

- Studies at Orlando show that male flies and mosquitoes sterilized by chemicals apparently retain full sexual vigor and competitiveness. In contrast, all species experimentally exposed to radiation have shown some degree of injury. Knipling estimates, for example, that sexual vigor of irradiated screwworm flies was reduced about 50 percent. This required doubling the number of sterile males released to provide the desired degree of competition with normal males in the native population. An effective chemosterilant that would not injure screwworm flies could have saved this extra cost and effort.
- A safe chemosterilant could be used in the field to sterilize native insect populations. Sterile females would be incapable of producing progeny, and sterile males would compete with fertile males in mating with any females that escaped the sterilizing treatment. This double effect would result in rapid reduction of the insect population.
- Using a chemosterilant against a *large* insect population in a natural environment would be cheaper and more practical than rearing, sterilizing, and releasing males. Also, any temporary hazard created by releasing additional insects would be avoided. If the infestation is *small*, however, the release of sterilized males would probably be more economical and practical. But even in laboratory sterilization, chemosterilants might be preferred to radiation—not only because chemically sterilized males appear to be stronger and more competitive but also because, in some cases, costs might be lower.

Some 60 to 70 of the approximately 2,000 chemicals screened show some degree of sterilizing activity. Most promising are half a dozen derivatives of ethylenimine, a family of chemicals used in cancer-therapy research. These chemosterilants are considered toxic to warm-blooded animals and could only be used under carefully controlled conditions.

Researcher sprinkles sterilant, in a sweetened cornmeal bait, on a refuse dump heavily infested with houseflies.

Grids placed on the refuse dump showed fly infestation was heavy at start of test.



After 5 applications of sterilant, grids were free of flies. The infestation was almost wiped out.

They could be used safely, for example, to sterilize artificially reared insects, as irradiation was used in the screwworm program.

They might be safely added to a powerful attractant, even though too hazardous for field use as conventional sprays or dusts. Attractants are now in use or being tested on the gypsy moth, tobacco hornworm, European chafer, and fruit flies. Intensified research is underway to find attractants for other insects.

Screening is expected to increase

Screening of chemicals is expected to increase to several thousand a year, and evaluation techniques are being further refined. The scientists are optimistic, therefore, that the compounds they're working with are forerunners of chemosterilants that will be safe, even if applied as insecticides are now.

In fact, a combination insecticide-chemosterilant is visualized as one answer to the problem of insect resistance to insecticides. The insecticide would reduce the population, and the chemosterilant would destroy reproductive ability of survivors. Natural selection for resistance would automatically be halted.

Another joint use might be to apply an insecticide in areas where immediate control is essential, and then follow with a chemosterilant to prevent the surviving insects from rebuilding their population.

ARS entomologists and chemists emphasize that much more research must be done before chemosterilants can be used safely and effectively against native insect populations. The chemists must find the desired compounds, and the entomologists must learn how, when, and where to apply chemosterilants to specific insects without creating hazards to humans, animals, crops, or wildlife.

Effective cotton defoliant . . .

Abscisin

■ Discovery of abscisin, a plant growth regulator that occurs naturally in immature cotton bolls, may aid development of more effective chemical defoliants.

Abscisin, the first natural regulator known to promote drop of leaves and fruits, may be only one of a whole new family of such compounds. The two other families of naturally occurring regulators, the gibberellins and auxins, promote plant growth rather than abscission of leaves and fruits.

Machine harvesting requires that cotton plants be bare of leaves. But commonly used defoliants are not always effective and sometimes must be applied two or three times. Particularly resistant to defoliants at harvest time are big, leafy, still-succulent, growing plants stimulated by irrigation and heavy applications of fertilizer.

Only one ten-millionth of a gram of abscisin per cotton leaf was needed to effectively accelerate defoliation of cotton in cooperative research by ARS plant physiologist H. R. Carns and biochemist Wen-Chih Liu at the University of California, Los Angeles.

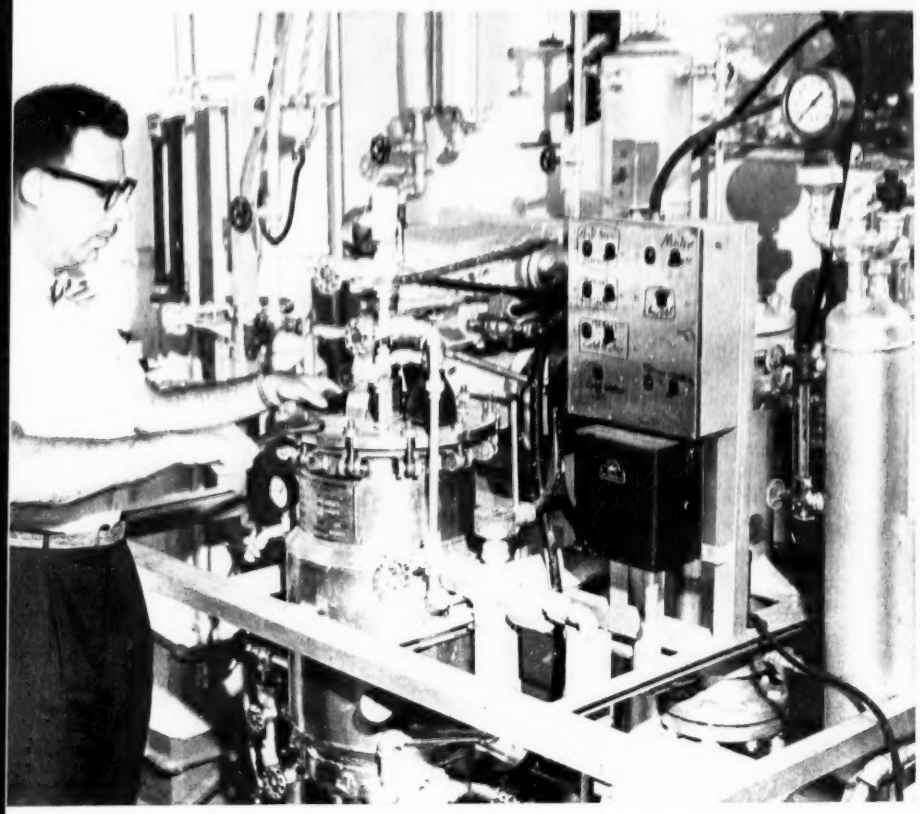
After observing the high natural rates of drop of immature cotton bolls of some varieties, the scientists experimented with boll extracts to study defoliation effects. Extracts from UA7–9 cotton, which loses 77 percent of its bolls, contained more of the compound that promotes leaf drop than extracts of West Texas Rough cotton, which loses only 53 percent of its bolls.

To obtain enough material for extraction and crystallization of this growth regulator, more than 300 pounds of dried fruit walls of the widely grown Acala 4–42 cotton were used. Acala 4–42 is intermediate with respect to boll-dropping characteristics.

Twelve pounds of fruit walls yielded one one-thousandth of a gram of abscisin. Inexpensive sources of abscisin, suitable for commercial use, may be discovered after scientists identify the regulator's chemical structure.

In addition to their search for ways of using abscisin to improve defoliation, ARS scientists are seeking compounds to counteract its drop-accelerating action during boll development.

Retention of early set bolls would minimize boll weevil and weather damage by permitting earlier harvest. Moreover, effective abscisin counteractants would increase yields in cool, wet seasons, when natural drop of immature bolls is especially heavy.



Wasserman uses pilot plant, built at Eastern utilization laboratory, for the new conversion process.

WHEY CAN BE CONVERTED TO YEAST

Millions of pounds of protein, now lost, may be saved for use in making foods and feeds

■ Cheesemakers and feedstuff producers may find good use for a USDA method of converting whey into yeast.

This technique, developed by ARS biochemist A. E. Wasserman and associates, may release for food and feed uses millions of pounds of protein now lost in the billions of pounds of whey disposed of annually as waste. The 9 pounds of whey left for every pound of cheese made is an expensive waste. Unless treated by costly procedures, its disposal pollutes streams and kills aquatic life.

The conversion process begins with heavy seeding of whey with *Saccharomyces fragilis*, a yeast that grows well on whey sugar. This initiates propagation of yeast from lactose in the whey. With a generous supply of oxygen to keep the process going, a half pound of yeast is produced in 3 to 5 hours from each pound of the whey sugar.

Wasserman says yeast made by this process is 50 percent protein and similar in amino acid and vitamin content to other yeasts used in foods and feeds. Waste liquids that remain after the yeast is made can be readily processed by conventional waste-disposal methods.

Heat sterilization of the whey before inoculation with the yeast starter, although not necessary to make yeast, separates a protein fraction from the whey in the form of a precipitate. This can be removed and sold as a byproduct without affecting subsequent yeast growth.

Cheesemakers using the conversion technique would use raw whey, and feedstuff producers could process whey concentrate into yeast. Commercial studies are being made to determine if these processing methods can be used profitably.

May be gain even if no profit

Even if cheesemakers make little or no profit, however, they may gain from using the conversion technique by not having to pay for treating whey so it can be lawfully and safely discharged into streams.

A commercial process for spray-drying cottage cheese whey into a powder for use in feeds and prepared foods has also been developed (AGR. RES., August 1961, p. 15) by ARS dairy scientists F. P. Hanrahan and B. H. Webb. These Eastern utilization division researchers are stationed in Washington, D.C. Wasserman is stationed at the division's main laboratory in Wyndmoor, Pa.☆

PROFIT FROM FARM SUPPLIES AND SERVICES?

■ Does it pay for a marketing cooperative to handle farm supplies and services?

It can, if supply operations are carefully managed and fitted to farmer-members' needs. This is the conclusion of USDA's Farmer Cooperative Service after a study of supply operations of 26 Texas grain and cotton gin cooperatives.

FCS agricultural economist J. M. Bailey analyzed operating results, policies, and practices of the cooperatives. Interviews with their managers supplied information on problems encountered and advantages or disadvantages of offering supplies and services.

Advantages noted, besides provision of supplies to farmers at lower cost, were: (1) Reduced operating costs; (2) increased marketing volume; and (3) ability to offer better services than farmers could obtain individually, such as renting fertilizer equipment.

Total operating costs per unit were reduced by having marketing *and* supply operations contribute to payment of fixed costs of facilities and equipment, and the salaries of employees who worked for both services.

Having employees work in both marketing and supply operations could be a disadvantage, however. An effective gin hand, for instance, might not be a good supply salesman. Another factor to consider is that the increased capital needed for supply operations may slow down return of marketing savings to farmers.

Suggestions for successful supply operations made on the basis of this study and other FCS research may help other cooperatives to establish or expand such services. Some of these suggestions are:

- Start with basic supplies and services, such as feed, petroleum, or fertilizer.
- Obtain adequate capital.
- Buy supplies from regional cooperatives to make wholesale savings.☆

Progress report

CONQUERING THE CASTORBEAN ALLERGEN

■ A method processors may be able to use to inactivate the potent allergen in castorbean meal has been developed by pioneering research scientists of USDA's Eastern utilization division, Washington, D.C.

This technique—heating the meal in the presence of lime—will enable industry to make faster progress in developing castorbeans as an important domestic oil crop.

There are many important actual and potential uses for castorbeans, now largely an imported commodity. For example, castorbean meal, heat-treated to destroy its poisonous component ricin, is a nutritious feed supplement. And ARS utilization research is providing ways for industry to increase use of castor oil.

This allergenic effect was discovered almost 50 years ago, and its high potency as a cause of asthma was soon recognized. ARS scientists in the early 1940's demonstrated the unusual ability of the allergen to resist inactivation by chemical or physical treatments. Other scientists thought the material was connected with ricin until they found that moist heat, which easily destroys ricin, has no effect on the allergen.

No reaction to treated allergen

Using results from tests made on laboratory animals and humans, ARS researchers determined the conditions of time, temperature, and degree of alkalinity necessary for the inactivation with lime. Tests on human volunteers were made by a cooperating physician. When he used the treated allergen, no individual reacted—even if given a concentration 2,000 times greater than the untreated one, which produced a complete reaction.

ARS utilization scientists at Albany, Calif., are separating components of the allergen and testing the potency of each on a species of monkey. And these researchers are considering the effect of the heat treatment with lime on usefulness of castorbean meal.

Present studies at Albany are aimed at finding the relative merits of untreated and treated meal for industrial and feed uses. For example, tests are underway to determine whether heat treatment with lime will limit the nutritional value of castorbean meal as a feedstuff. If necessary, the scientists will try to modify the treatment so that the allergen is destroyed and there is minimum loss in value of the meal.☆

Methods of gaging test plants' resistance to a damaging insect aid much in developing . . .

BORER-RESISTANT CORN HYBRIDS

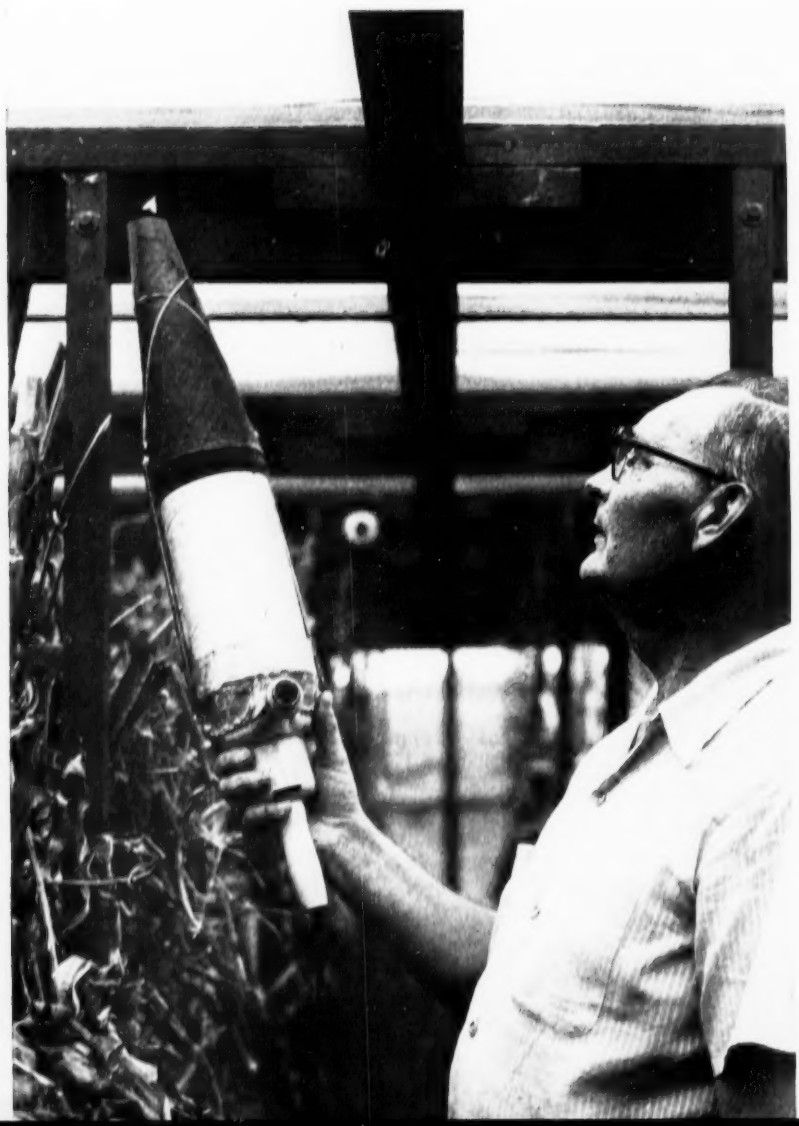
■ Techniques for accurately measuring the ability of corn plants to resist attack by the European corn borer are aiding considerably in development of hybrids resistant to the destructive insect.

These methods, devised and perfected by USDA scientists at Ankeny, Iowa, are helping plant breeders of State agricultural experiment stations and commercial seed companies.

First step in the procedure is to artificially infest test plants in the field. This is begun by collecting corn borer moths and placing them in special laboratory cages. Eggs laid by these moths are then transferred by hand to plants in the field, ensuring uniform infestation.

Next, an evaluation is made of different degrees of genetic resistance or tolerance of plants to first and second broods of the borer.

Resistance to first-brood borers is judged by the amount of leaf injury



1. Moths are collected (left) from infested stalks by Dicke in trap devised at laboratory.

borer larvae begin feeding in the whorl, or bud, of young corn. As leaves grow, the pattern and extent of damage and survival of larvae provide an index of resistance.

Tolerance to second-brood borers is indicated by the extent of tunneling the larvae do in stalks and ear shanks, and by the amount of stalk breakage and number of ears that fall to the ground. In the Corn Belt, second-brood borers usually invade stalks and shanks after ear development is nearly complete.

These methods were worked out by the ARS team of entomologist F. F. Dicke and agronomist L. H. Penny. They cooperate with the Iowa Agricultural Experiment Station.

Resistant inbred lines developed in their research are released to breeders. The latest line is B–42, released in 1960. Scientists at Ankeny also cooperate in tests of lines developed at State stations.☆

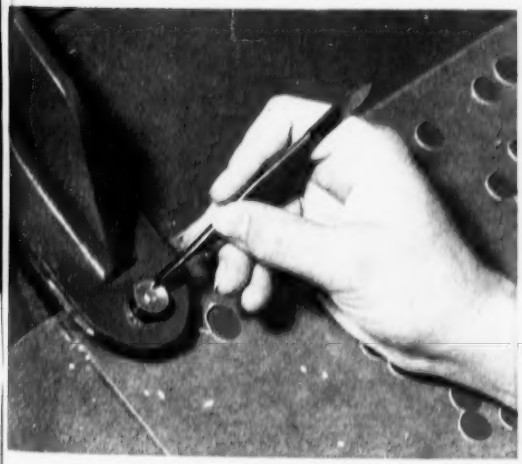
6. Little damage in plant at left shows most larvae have died; plant has high (class 1) resistance. Plant at right is graded class 9, bottom of scale; many and long leaf, midrib, and sheath injuries indicate many larvae survived.

5. Egg masses are dropped in leaf bud of each plant. Degree of resistance to first-brood borers is gaged as leaves grow out.

2. Moths are caged (left) in room where temperature and humidity are controlled. Females lay eggs on strips of wax paper.

4. Disks are pinned to board and taken to field to infest plants.

3. Disks holding egg masses are cut out by special electric punch.



Research aid:

COCCIDIA DEVELOPED TO RESIST DRUGS

■ A drug-resistant strain of coccidia (parasites that cause coccidiosis in livestock) has been developed by USDA scientists. The researchers want to learn if such resistance may be overcome—and if there are drugs to which the parasites cannot develop resistance.

Coccidia of the species that cause cecal coccidiosis in chickens gradually acquired resistance—in the laboratory—to every drug tested. And ARS parasitologists D. K. McLoughlin and J. L. Gardiner say these coccidia may now have resistance to drugs that haven't been tried.

The researchers discovered that the coccidia, in building resistance to one drug, occasionally may exhibit resistance to another. This indicates that outbreaks of coccidiosis in flocks already receiving a drug won't be controlled by use of another drug—if coccidia in the flock are resistant to it.

Development of such cross-resistance, however, doesn't necessarily work both ways. For example, coccidia exposed to one drug, *A*, gain resistance to it and to an untried one, *B*. But if the coccidia are exposed initially to drug *B*, and develop resistance to it, they may remain susceptible to drug *A* until exposed to it long enough to build resistance.

McLoughlin and Gardiner hope studies can be made of all species of parasites causing poultry coccidiosis, so cross-resistance information will be available on drugs being used. They also plan to classify various drugs according to how quickly coccidia are able to build resistance to them. These studies are being conducted at USDA's Parasitological Laboratory, Beltsville, Md.

To develop resistance in coccidia, the scientists first allow the parasites to pass through birds that receive less than a recommended dose of drug. This permits many of the parasites to survive.

Survivors are then passed through chickens that are treated with stronger doses of the same drug. Eventually, the surviving coccidia gain enough resistance to cause observable coccidiosis in treated birds.

These coccidia develop within and destroy cells lining the walls of the ceca—blind pouches in the intestine. This causes severe bleeding and often results in death.☆

NEW FINISHING PROCESS FOR COTTON WASH-WEAR

■ A new chemical finishing process, devised by USDA utilization scientists to give cotton improved wash-wear characteristics, is being evaluated by the textile-finishing industry.

Plant-scale experiments by four firms indicate commercial application of the treatment is feasible. One of these firms is marketing limited quantities of the treated fabric to determine consumer acceptability.

This new finishing process, which uses formaldehyde to bind together cotton's cellulose molecules, is a development of the ARS Southern utilization division in New Orleans, La. Chemists responsible for the formaldehyde treatment are L. H. Chance, Rita M. Perkins, and W. A. Reeves.

The new finish appears to be more durable than many other types of wash-wear finishes now in use. And the formaldehyde-treated fabrics show no tendency toward yellowing or other discoloration when subjected to chlorine bleach. Changes in the feel of the treated fabric are slight.

Fabrics given the finish in pilot-plant tests rated high (4-plus or 5) on the standard wash-wear rating scale of 1 through 5. Garments made from the treated fabrics can be either line- or machine-dried.

Although the chemical cost is about the same, the formaldehyde treatment takes longer and requires more equipment than most of the wash-wear treatments now in use. Consequently, overall costs of the new finishing process are higher than those of most other processes, which range from 5 to 10 cents per square yard. Most cotton textile finishing plants already have the equipment needed for the formaldehyde process, but some modification of present operations will be required.

A distinguishing feature of the new treatment is the time the fabric must remain in the chemical solution. In most of the commercial finishing processes the fabric moves rapidly through a chemical solution, then through squeeze rolls where excess solution is removed. Then the material goes through an oven where heat cures the finish and dries the fabric. In the new process, however, the fabric must remain wet with the solution for about 30 minutes.

To apply the new finish, fabric is placed in a water solution of formaldehyde, hydrochloric acid, and acetic acid or calcium chloride (both appear to work equally

well) at room temperature. The water causes the cotton fibers to swell, and acetic acid or calcium chloride controls the degree of swelling. The formaldehyde then enters the slightly swollen fibers and, catalyzed by the hydrochloric acid, reacts with the cellulose to bind the molecules firmly together. This binding gives the fabric a strong tendency to dry flat, thus imparting wash-wear characteristics.

There have been many attempts to make use of the advantages offered by formaldehyde, which was one of the first chemicals tried as a wash-wear finishing agent. But the reaction of cotton with formaldehyde is difficult to control, and in the earlier trials the loss of fabric strength was excessive.

In the new process, fabric strength losses can be kept low enough that test garments last as long as those given other types of wash-wear finishes.☆

MORE FORAGE FROM GREAT PLAINS RANGELAND

■ An effective way to spread available runoff water, combined with judicious use of nitrogen fertilizer, more than doubled forage production in experiments on dry native rangeland in the Northern Great Plains.

This research showed that available moisture largely determines how much fertilizer the grasses will use—and that applications of fertilizer are needed to assure efficient use of limited moisture in the area.

These studies to test the value of fertilizer used in combination with water spreading to supply additional moisture were conducted by ARS soil scientist H. R. Cosper. He worked near New Underwood, S. Dak., in cooperation with USDA's Soil Conservation Service and the South Dakota Agricultural Experiment Station.

(Water spreading is a means of concentrating runoff and delivering it to range reserved for hay production. A typical installation consists of an earth dam to trap runoff, and a system of dikes and ditches to store and distribute the water by gravity.)

Cosper applied nitrogen fertilizer in the fall to range predominantly in Western wheatgrass and needlegrass, then measured production of dry forage the following two seasons.

Application rates were 40, 80, and 160 pounds of fertilizer per acre. In the first year after fertilization, the check plot yielded 985 pounds per acre. Yields from fertilized plots were 1,640, 2,100, and 2,660 pounds per acre, respectively.

All yields dropped the next year, because precipitation in winter was so limited there was no runoff to spread. Even so, fertilizer boosted yields. The check plot yielded 581 pounds an acre. Plots getting 40, 80, and 160 pounds of fertilizer yielded 919, 807, and 1,051 pounds.

Total increases in yield on the test plots for the 2 years following nitrogen application were 63, 105, and 135 percent.

Fertilized grass also had a higher crude protein content—increases in crude protein were 65, 133, and 207 percent.☆

Proper temperature may boost feed value

■ Cattle on pelleted feed usually gain weight more efficiently than if fed a ground ration. Scientists don't know all the reasons why; some believe that heat involved in the pelleting process changes feed so it can be utilized better.

USDA experiments are underway to see if temperatures of about 150° to 225° F. boost feed value. Object of these studies is to determine if there are temperatures, comparable to the ones involved in pelleting, that enhance the value of feed.

If this is so, heat will be another factor—in addition to fineness of grind—known to make pellets an efficient feed.

A recent study showed that a temperature of 260° F. reduces feed value. (Temperatures lower than 260° develop when feed is processed into pellets.) Researchers think the high temperature lowers the quality of protein in the feed or makes it less available for digestion by cattle.

In this study, a bermudagrass-corn ration in three different forms (ground, pelleted, and ground and heated to 260° F.) was fed steers at the Agricultural Research Center, Beltsville, Md. ARS animal husbandmen P. A. Putnam and R. E. Davis made the study. Steers receiving the ground ration gained 1.79 pounds per day, and those getting pellets gained 2 pounds daily.

Animals on the ground-and-heated ration averaged only 0.29 pound of daily gain. And these steers lost weight until a protein supplement was added to their diet.☆

In studies of soil moisture and sediment, scientists have found that . . .

RADIATION PROBES OFFER ADVANTAGES

■ Two new uses for nuclear radiation—determining the density of sediment in water and locating and measuring moisture in soil—have been adopted by USDA scientists.

Two types of relatively new and commercially available instruments known as radiation probes are used to make the moisture and sediment tests. These devices provide an important advantage—researchers can measure a representative portion of the region under study. Older methods involved the use of small samples that often were not representative. Furthermore, use of radiation probes may result in 99 percent accuracy. The accuracy of old methods was unpredictable and generally lower.

Benefits can result from findings

More precise information on sediment density will aid in learning how to better understand and control this damaging material that forms as a result of erosion. Sediment causes damage by depositing in reservoirs, lakes, rivers, streams, and on flooded land (AGR. RES., September 1959, p. 8; July 1961, p. 8). Farming practices, such as irrigation timing, can be improved if we know more about how far rain penetrates soils, differences in the amount of soil moisture at various depths, and the position and extent of water tables.

A gamma probe is the instrument used to measure sediment density. By knowing sediment density in different parts of a reservoir, scientists can calculate the total amount of the deposit to estimate how much erosion has occurred in watersheds upstream. And they can figure the present and future storage capacity of the reservoir. Total sediment weight could not be accurately determined previously.

This probe consists of a metal cylinder containing radium 226 and a gamma detector. Dense sediment deposits around the probe absorb much radiation; little is deflected to the detector. Thus, low readings indicate high density, and *vice versa*.

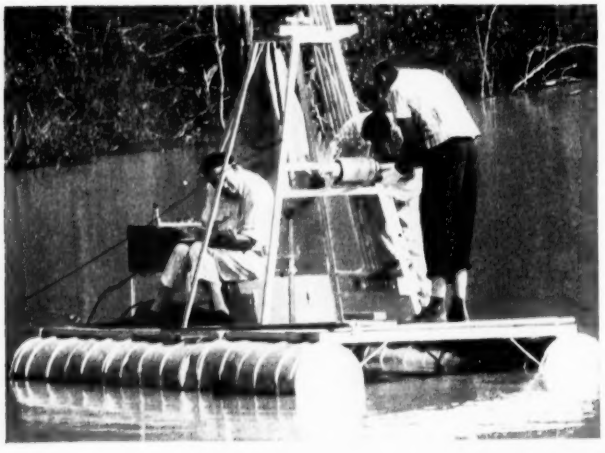
A neutron probe is used to make the moisture tests. This probe, which uses radium-beryllium as a source of neutron radiation, is used inside a special tube installed in the ground. Many readings may be taken at the same spot at different times because the tube is left in place until the tests are complete. (Repeated measurements by the old method were not so readily made.) These tubes can also be used with a gamma probe to test soil density and compaction.

The sediment density probe was developed by researchers at the St. Anthony Falls Hydraulic Laboratory in Minneapolis, Minn., under the sponsorship of the Interagency Committee on Water Resources.

Gamma and neutron probes for measuring sediment density and soil moisture distribution have been used routinely in hydrologic research for 3 years at Oxford, Miss., by ARS scientists cooperating with the University of Mississippi and Mississippi State University.

Use of the new radiation probes results in *no* contamination of water or soil. Both probes can be safely used by trained personnel.

New methods are now being developed to improve the versatility and usefulness of these techniques.☆



Researchers use gamma density probe to measure sediment deposits in lakes, reservoirs, rivers.

Neutron probe used for determining soil moisture is inserted in special tube installed in ground. Readings can be taken at different times and depths.

Object:
MORE EFFICIENT DRAINAGE OF EASTERN FIELDS

This may be accomplished if more can be learned about how water moves in soil, causing troublesome wet spots

■ Drainage systems more efficient than those now in use may be developed for Eastern farms when scientists learn more about how water moves in the soil.

This water often moves to the surface and causes small wet areas that don't dry up until late summer, if at all. Few types of crops can be grown on affected fields; yields are small, and maneuvering mechanical equipment around wet spots is difficult.

Researchers believe *most* water in these wet spots comes from within the soil, not from runoff. Now USDA, in cooperation with the Vermont Agricultural Experiment Station, is trying to find how the water gets there by determining factors governing its movement.

ARS agricultural engineer J. Bornstein is conducting these studies near East Franklin, Vt., using test plots set up on a large, sloping field typical of many in the East. Plots have diversion terraces, tile drains, or a combination of these. Bornstein wants to learn what effect each system has on movement of water in soil.

The amount of water flowing from each plot is measured by automatic gaging devices. Water moving in the soil is traced by using a series of piezometers.

A piezometer is a pipe driven to a specific depth in the soil. The level of water in the pipe is used to determine the water pressure at its bottom.

For example, in a pipe driven 2 feet into the soil, water may rise to within 6 inches of the surface. But water might not enter an adjacent pipe driven 1 foot into the soil. This indicates water is trapped below a dense soil layer. But where such water reaches the surface, an excess may exist, causing the wet spots.

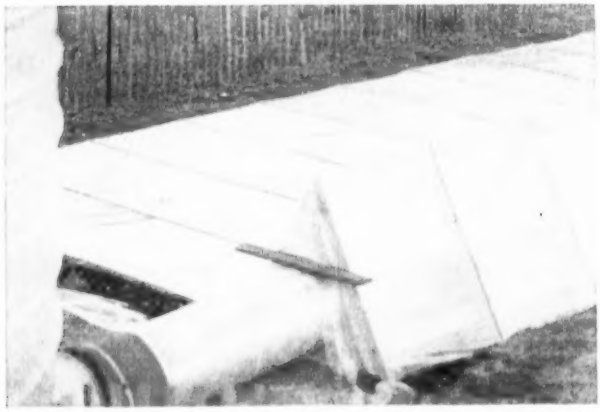
By placing several groups of piezometers in a line along the slope of the field, Bornstein can observe changes in soil water pressure that are caused by different drainage methods.

When the effect of each drainage method on the water table has been evaluated, a complete drainage system will be installed in the field. The system will be evaluated and the information used to predict what may happen when drainage systems are installed in other fields. This should lead to development of methods for designing improved drainage systems.☆

Meter indicates when electrical circuit is completed by probe being lowered into piezometer by Bornstein. Measurement aids tracing of soil water movement.

Various uses possible for new solar heat collectors

They may be useful for drying grain, warming homes and animal shelters



Solar heat collected by flat unit is moved into bin through tentlike exhaust duct.

Duct is connected to bin holding 1,000 bushels, maximum recommended for drying with these experimental solar units.

■ Two solar heat collectors—designed for drying grain but with other potential uses on farms—have been developed by USDA and Kansas agricultural engineers.

Each collector has transparent plastic to admit sunlight at the top and sides, and black plastic on the ground to absorb heat and prevent entry of moisture. Warmed air in the collectors is drawn by a fan into a grain-drying bin. The collectors store only limited quantities of heat and operate best in full sunshine.

These devices were developed at Manhattan, Kans., where the use of solar energy for grain drying is being studied by C. P. Davis, Jr., of ARS, and R. I. Lipper of the Kansas Agricultural Experiment Station.

The collectors, being tested as grain dryers, may also prove useful for other heating purposes. Two uses suggested by the designers are to provide warm air in animal shelters and supplementary heat in rural homes.

One of the devices consists of a low, flat unit that collects solar heat energy. This warms air that is fed into a tentlike exhaust duct. Transparent and black plastics in the unit are held apart 3⅝ inches by a wood frame. The complete assembly covers a ground surface of approximately 300 square feet.

The other device is an inflated bag (transparent plastic on the top and sides and black plastic on the bottom) kept inflated by maintaining the internal air pressure slightly higher than that outside. This unit, covering 100 square feet of ground surface when inflated, is lightweight, portable, and easy to store.

Units are inexpensive to build for use as grain dryers

Both devices are inexpensive to build and as efficient for drying grain as an earlier roof-surface collector (AGR. RES., May 1960, p. 14), the engineers say. Although polyethylene was used in the experimental models, a more weatherproof plastic is needed.

The collectors can be adapted easily to standard equipment used to dry grain with unheated air. As the temperature in each collector rises (as much as 25° F.), the relative humidity is lowered. This warmer, drier air dries the grain more quickly and efficiently than unheated air.

Limited experiments indicate that only half as much electrical energy is needed to run air-circulating fans when solar-heated air is used to dry grain as when unheated air is used. Solar heat-collecting equipment is best suited to farms where the volume of grain produced is too small to be dried economically by conventional fuel-fired equipment.

The new collectors are not ready for general use. Research is continuing on the economics of trapping solar energy and on devising more efficient units.☆

AGRISEARCH NOTES

New source of nitrogen for feed

High-nitrogen molasses, the byproduct of an experimental sugar-refining process, may become a valuable source of nitrogen in cattle rations.

Some molasses, ammoniated to boost its nitrogen content, has caused nervous disorders when fed to cattle. USDA research shows that the new byproduct causes no trouble.

Steers receiving the byproduct gained weight as efficiently as those getting a comparable ration containing regular molasses and urea. The

urea—a nitrogenous compound used as a supplement to increase protein in feeds—was added to make the rations equal in nitrogen. The feeding trial took place at the Agricultural Research Center, Beltsville, Md.

Further studies by ARS animal husbandman P. A. Putnam and associates are being conducted to see how nitrogen from the high-nitrogen molasses is utilized by animals.

The promising byproduct is higher than regular molasses in nitrogen because of an ion-exchange technique used in the new process for refining sugar. This process is being developed by a company in Puerto Rico.

Publication on perishable foods

Advice on what foods to put in the refrigerator and how soon to use various foods after purchase is given in a new USDA publication, *Storing Perishable Foods at Home*. It gives specific storage suggestions for most common foods and also discusses food spoilage.

Most perishable foods keep longest and best in the refrigerator, but the bulletin points out that some varieties of apples and some root vegetables keep well in a cool basement or outdoor cellar. Also, a few fruits and vegetables such as eggplant, citrus fruit, melon, and pineapple keep well at room temperature.

Normal operating temperatures for most refrigerators are between 38° and 42° F. Homemakers are advised to check the temperature periodically by placing an ordinary indoor thermometer in different parts of the general storage area. If the temperature is above 42°, the control should be adjusted for a lower temperature.

Single copies of the publication, Home and Garden Bulletin No. 78, are free from the Office of Information, U.S. Department of Agriculture, Washington 25, D.C.

Treatment induces azalea budding

A new chemical treatment will enable florists and nurserymen to supply blooming azaleas any time of year.

Blooming and ready-to-bloom azalea plants in pots are popular in winter and spring because azaleas have a wide range of flower colors and their flowers are long lasting. Using chemicals to produce blooming azaleas out of season is comparable to manipulating day length to produce blooming chrysanthemums out of season.

ARS plant physiologist N. W. Stuart at the Agricultural Research Center, Beltsville, Md., discovered the treatment when he applied the growth-retarding chemicals phosfon and CCC to azaleas. Treated azaleas ceased shoot growth and set flower buds. Either chemical is effective when dissolved and applied as a soil drench; CCC is effective as a foliar spray also. The treatment forces bud development; flowering occurs after treated plants are held under controlled temperature and light conditions.

After chemical treatment, existing growing conditions are maintained for 2 months. For the third month, plants are put in a cold room (50° F.) and illuminated 12 hours daily. Exposure to this temperature satisfies azaleas' prebloom cold requirement; 12 hours' illumination daily prevents leaf drop. Blooming takes place 4 to 6 weeks after the plants are removed from the cold room.

Phosfon and CCC are the first chemicals found to force woody plants to bud. Why budding is stimulated is not known. Experiments are being continued to determine reactions of camellias, rhododendrons, burning-bush, and other woody shrubs.

Trend to frozen, canned vegetables

We'll be eating more frozen and canned vegetables—and less fresh produce—in the next 10 years, according to agricultural economists of USDA's Economic Research Service.

Their prediction is based on studies of consumption patterns, incomes, changes in rural-urban populations, and other factors. Since World War II, there's been an increasing trend toward use of more processed vegetables, especially frozen products. This is partly because of the continued

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shift of the population from farms to urban areas, and the resulting decrease in farmers' production of food for their own use.

Other reasons for the shift to processed vegetables are: their increasing variety and availability, more uniform quality, convenience in use, and much more stable prices. Another factor

is higher incomes of consumers. According to the economists, as consumers' incomes rise, so does their use of processed commodities.

Total consumption of vegetables per person isn't expected to change much from the level of the last decade. Average annual consumption per person for the past 10 years has been about 110 pounds of potatoes and 260 pounds of other vegetables.

Consumption of sweetpotatoes and of dry beans and peas, which has declined continuously in the last two decades, may level off because of new and improved processed products. In 1960, average total consumption per person was 7.7 pounds of sweetpotatoes and 8.1 pounds of dry beans and peas.

Control for viruses in carnations

Some vegetatively propagated varieties of carnations, seldom produced commercially now because of losses caused by viruses, may find favor again because of a new heat treatment being tested by USDA.

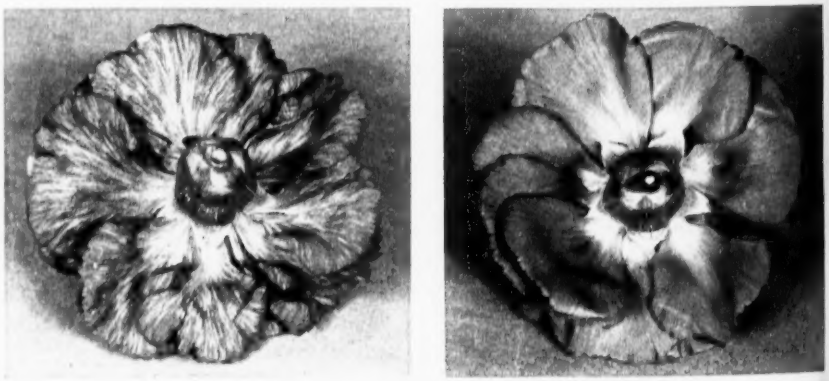
This heat treatment practically eliminates four viruses—mottle, streak, mosiac, and ringspot—from the King Cardinal carnation. It was once a popular and high-yielding variety. If other virus-affected carnations can also be heat treated successfully, they are likely to perform at least as well as uninfected ones newly selected from seed. Propagation of carnations from seed is not most desirable—it results in plants that are not true to type.

Beginning about 15 years ago, the vegetatively propagated King Cardinal became infected by viruses that cause breaks in the color pattern of the blooms. Consequently, its flowers lost all commercial value, and growers discarded it. Other carnations have also been discarded because of the same defect.

The new heat treatment consists of keeping the carnations in a greenhouse for 2 months at a continuous temperature of 100° F. This reduces the total amount of virus in the plants and eliminates virus in the top three-eighths inch of *some* stems.

Next, shoot tips of these plants are rooted with their attached leaves. Tests of these selections on virus-susceptible plants then reveal which of the shoot tips are not infected by virus. Carnation stock grown from these shoot tips should remain virus free for years, if modern propagation and greenhouse production methods are used.

ARS plant pathologist Philip Brierley used the treatment successfully on the King Cardinal carnation at the Agricultural Research Center, Beltsville, Md. He is planning to test the treatment on a fifth virus, detected in some carnations, but not in King Cardinal.



Flower (left) is from plant with all four viruses; other flower is from plant propagated after heat treatment.

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